A Proposal For:

Bozeman Pass Wildlife Linkage and Highway Safety Pilot Study (REVISED 1/23/03)

Submitted by

F. Lance Craighead
Craighead Environmental Research Institute
201 South Wallace Ave.
Bozeman, MT 59717

Amanda Hardy
Western Transportation Institute
Montana State University
416 Cobleigh Hall
Bozeman, MT 59717
(406) 994-2322
ahardy@coe.montana.edu

Submitted to

MONTANA DEPARTMENT OF TRANSPORTATION
RESEARCH MANAGEMENT UNIT
2701 PROSPECT AVENUE
HELENA, MT 59620

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Problem Statement

Animal-vehicle collisions threaten human safety. Each year, more than 200 motorists are killed and thousands more are injured in animal-vehicle collisions. The insurance industry estimates that the annual cost to society for these fatalities and injuries is $200 million. Individual motorists usually pay at least $2,000 in vehicle repair every time they hit a large animal (U.S. Dept. of Transportation 2000, WARS Canada 2000). Not only are animal-vehicle collisions a traffic hazard and a cause of significant property damage, but highways and the motoring public can threaten wildlife populations through direct mortality, habitat loss, and habitat fragmentation (Clevenger et al. 2001, Critter Crossings 2000, Jackson 1999).

The Rocky Mountains run north to south. Landscape features, such as mountain passes, are natural conduits for wildlife movement. Forest Service biologists have identified Bozeman Pass as a high-priority, key linkage area for wildlife movements between the Greater Yellowstone Ecosystem and the Bob Marshall/Glacier Ecosystems in the Northern Rockies (Ruediger et al, 1999). Located between the growing communities of Bozeman and Livingston, Montana, Bozeman Pass accommodates a transportation corridor including Interstate 90 (I-90), frontage roads and the Montana Rail Link (MRL) railroad. This east to west transportation corridor bisects the Bozeman Pass wildlife linkage area and is a likely barrier for animal movement in the region. Current traffic volumes between Manhattan (west of Bozeman) and Big Timber (east of Livingston) are estimated at 8,000-12,000 daily vehicles during the winter and 10,000 to 15,000 daily vehicles during the summer (Gordon Stockstad, Personal Communication). At current levels of use, I-90, frontage roads, and the MRL railroad pose a significant risk to many species of wildlife (Woods and Munro 1996). Elk, deer, mountain lions and bears are occasionally killed on the highway (Jim Allard, Personal Communication). At least fifteen black bears have been killed in the past two decades near the Bear Canyon exit (Sam Nelson, Personal Communication). In 1998, thirty-nine animal carcasses were reported between East Bozeman and Bozeman Pass. (Carl Peil, Personal Communication)**.** During 2001, 86 ungulate carcasses were recorded on Bozeman Pass. While it is estimated that one in ten animal-vehicle accidents are reported to insurance companies, claims from all 86 ungulate accidents on Bozeman Pass in 2001 alone could have amounted to $172,000 to those motorists involved. Traffic volumes on I-90 between Bozeman and Livingston are expected to increase as the populations of those cities increase, and as visitation, commercial transportation, and other highway use grows. As traffic volumes increase, safety risks and economic impacts increase and I-90 may become a more serious barrier to animal movements.

With the inevitable growth in human populations and traffic volumes, it is imperative to anticipate the effects of these conflicts to fulfill the mandates of Transportation Equities Act-21 regarding public safety and wildlife needs. Implementation and evaluation of wildlife conflict mitigation needs to be incorporated into transportation planning, highway design and

construction. Mitigation techniques currently in use include fencing and cattle guards to direct animals away from the highway and through underpass crossing structures. In some cases, existing underpass structures provide an adequate conduit for animal passage under highways. In other cases additional underpass or overpass structures have been constructed to allow animal movements across the road. Although crossing structures and design modification such as fences, cattle guards, extended bridges, underpasses, and overpasses have been evaluated to some degree in other states such as Florida and North Carolina, little is known about the effectiveness of using these techniques on a site-specific basis with respect to Montana's native wildlife. It is important to evaluate mitigation deployments in Montana to insure the Montana Department of Transportation that they are effective from a wildlife point of view, a human safety point of view, and that those options are as cost-effective as possible.

Background Summary

Different species of wildlife have specific habitat needs at various times of the day, season, year, and lifetime. Animals move to meet these daily, seasonal, and lifetime needs and across a wide range of scales from daily movements (meters to kilometers) to seasonal migrations (tens to hundreds of kilometers) to lifetime movements (thousands of kilometers in sum). Daily movements include travel from resting areas to foraging areas and to sources of water. Seasonal and yearly movements include travel from winter range to calving areas to summer range. Lifetime movements include dispersal of young animals from their areas of birth to establish new territories or home ranges. These movements of wildlife across landscapes are necessary for survival of individual animals and the persistence of the population and species. High volumes of traffic along transportation corridors can block, deflect, or delay such necessary movements, and pose a risk of injury and mortality to both wildlife and vehicle occupants.

The Bozeman Pass transportation corridor between Bozeman and Livingston, Montana, includes I-90, frontage roads, and the MRL railroad. There is strong evidence that the highway acts as a barrier to normal animal movements in the Bozeman Pass area. Elk, moose, black bear, mountain lion and deer are known to reside in and move across the landscape in the Bozeman Pass area; all of these species have been killed on the interstate during either local or seasonal movements. In anticipation of increasing traffic, serious accidents, and blockage of wildlife movement, it is wise to begin planning methods to allow both humans and wild animals to traverse this transportation corridor safely.

The Craighead Environmental Research Institute (CERI), based in Bozeman, has completed the first year of a study to determine the current extent of this problem and where it can best be mitigated. In 2001, CERI recorded a total of 127 medium-to-large sized animal road-kills along I-90 over Bozeman Pass. The greatest number of road-kills occurred between milepost 313 and 314 near the Bear Canyon exit and the MRL overpass. A Geographic Information System (GIS)

analysis of habitat conditions bordering the sections of highway in the study area has been done to determine the quality of habitat for movement of various species. Several assumptions about wildlife preferring certain types of habitat based on behavioral and ecological needs were used in the GIS model. All species move from one area of secure habitat to another area of secure habitat whenever possible, although the habitat through which they move may be less than optimal. Elk prefer to travel in open habitats where predators can be sensed and where flight is unhampered, but when necessary will conceal themselves in dense timber. Predators tend to travel in forest or along forest edges where concealment is possible both for stalking prey and for avoiding humans. The locations of the road-kills corresponded closely to the two probable wildlife 'corridor areas' mapped on Bozeman Pass using habitat characteristics and least-cost-path GIS analysis (Craighead et al. 2001).

Both the empirical data and theoretical model from the CERI study have begun to show the same trends about where animals cross between the Bridger and Absaroka Mountains, to the north and south of Bozeman Pass, respectively, and where wildlife mortality poses the greatest threat to human safety. With this information, CERI is working with the Western Transportation Institute (WTI) at Montana State University to submit animal-vehicle collision mitigation recommendations to Montana Department of Transportation (MDT) to incorporate into upcoming reconstruction projects in the Bozeman Pass area. Working with MDT early on to make slight modifications to reconstruction plans of existing overpass structures in this area could improve safety and ecological connectivity at a minimal cost compared to constructing new structures to achieve the same safety and ecological connectivity goals. Specifically, CERI and WTI would like to work with MDT and MRL to incorporate fencing, cattle guards and landscaping design modifications into the 2004 reconstruction of the MRL overpass near milepost 314, 7 km east of Bozeman (STIP Project # 4187). The purpose of incorporating such design elements into this project is to prevent animals from getting onto I-90 but to allow animals to travel under I-90 through the MRL overpass, hence avoiding a conflict between drivers and animal movements. The Butte District Administrator of MDT is tentatively willing to incorporate these concepts into the MRL overpass reconstruction project. WTI and CERI will submit these recommendations to MDT and establish an MRL contact to collaborate with on this project within the next month (March 2002). If these recommendations are accepted and implemented at the MRL overpass site in 2004, it will be important to evaluate the effectiveness of such design modifications in reducing animal-vehicle accidents and allowing animals to pass under I-90 through the redesigned MRL overpass.

This proposal to MDT involves the design and implementation of a pilot study to assess the effectiveness of incorporating highway fences, cattle guards, and landscaping to funnel animals under the road through an existing overpass structure with the goal of improving human safety and wildlife connectivity across I-90 on Bozeman Pass. If MDT chooses to incorporate the animal-vehicle collision mitigation recommendations into the MRL reconstruction, we propose to continue to systematically collect data on animal movements and vehicle collisions at the westernmost 'corridor area' under current conditions, and then to collect identical data at the

same site after design modifications have been constructed. CERI will augment the first year of their field study by continuing to collect baseline data throughout the year in 2003-2004, and then for at least one year after the reconstruction has been completed to evaluate the effectiveness of the mitigation efforts at reducing animal-vehicle collisions and increasing successful animal crossings under the interstate via the MRL bridge. Data collection methods will be identical during both the pre-construction and post-construction periods. Gordon Stockstad, MDT Environmental Resources Bureau Chief, has agreed to champion this proposed study in order to ensure the applicability of the results for MDT's needs.

Similar data to evaluate fences are available from studies in Banff National Park (Clevenger et al. 2001, Clevenger 1998, Clevenger and Waltho 2000). Data to evaluate underpasses are available from Florida and other areas (Evink et. al. 1996, Foster and Humphrey 1995, Jones 2000, Land and Lotz 1996, Langton 1989, MacDonald and Smith 1999, Veenbaas and Brandjes 1999) and more regionally relevant studies in Banff National Park, Alberta (Clevenger 1998, Clevenger and Waltho 2000, Gibeau and Heuer 1996, Leeson 1996, Paquet and Callaghan 1996) which suggest that underpasses and extended bridge spans are effective means to increase permeability for some species of wildlife. A review of literature was also done under contract to MDT (Irby and Podruzny, 2000). This proposed study will provide new data for additional species such as mountain lion, elk, black bear, and moose in a region with different topography and habitat than found in previous studies. Data from this project will be applicable to other areas throughout western Montana with similar suites of species, landscapes and habitats. This study is unique because, to WTI and CERI's best knowledge, there has been no research conducted in Montana to determine if the retrofitting of existing crossing structures for the purpose of passing wildlife under roadways is a successful and cost efficient technique to mitigating animal-vehicle collisions and increasing ecological connectivity.

Beyond the transportation corridor, data from this research will be help guide efforts to preserve land for ecological connectivity in the Bozeman Pass area. While reducing wildlife-transportation conflicts is a key piece of the wildlife linkage puzzle, conservation of relatively undisturbed tracts of land beyond the right of way on Bozeman Pass is equally critical to preserving connectivity in this area. Data from this study will be used to influence public land management decisions and support land conservation efforts north and south of the transportation corridor to allow animals to move throughout critical habitat to safe passage areas across the transportation corridor. A multi-disciplinary working group has been cooperating to address transportation-wildlife issues and the conservation of habitat in the Bozeman Pass area to preserve this important landscape corridor for wildlife movements. WTI and CERI are involved with and will continue to collaborate with this group throughout this proposed study; although the commitment to the working group activities are independent from this study's request for funding. MDT has been attending the working group meetings addressing transportation planning and mitigation measures and is an influential partner in this effort.

MDT's efforts to address the transportation-wildlife conflicts on Bozeman Pass will be critical in any attempt to maintain ecological linkage in this area. This project offers a unique opportunity to dually address public safety and ecological connectivity in an important transportation corridor. By adding some fairly inexpensive and simple design features into existing overpass reconstruction plans and by following with an effectiveness evaluation as this study proposes, MDT can pro-actively approach this problem in a step-wise manner, investing incrementally until the desired result is achieved. This adaptive management approach could be widely applicable for future highway reconstruction projects occurring in other areas of Montana with similar wildlife-transportation conflicts. The results from this study will be pivotal in understanding specifically, the effectiveness of wildlife mitigation measures on Bozeman Pass, and more globally, the applicability of an adaptive management approach to address both transportation-wildlife conflicts and public safety issues within the constructs of upcoming reconstruction opportunities. Through this proposed study, MDT can make a coordinated commitment to environmental stewardship, planning and design, and quality science for the furtherance of their best management practices concerning wildlife-transportation and related human safety issues.

Objectives

The goals of this study are to address the question of whether or not fences and cattle guards are effective at a) reducing the number of animal-vehicle collisions, and b) re-directing animal movement patterns through existing highway 'crossing' structures (e.g., road and railroad bridges and culverts). The proposed study will continue to document the location of animal-vehicle collisions, locations of highway crossings by animals both over the highway and through existing 'crossing' structures, and locations of attempted crossings. Specific objectives include the following:

1. Continue to document the pre-construction wildlife use of the under-bridge crossings and over-highway crossings at the study site for various species throughout the year.
2. Continue to document the number of animal-vehicle collisions at the study site under pre-construction conditions.
3. Document the post-construction wildlife use of the existing 'crossing' structures at the study site for various species at equivalent times and seasons.
4. Document the number of animal-vehicle collisions at the study site under post-construction conditions.
5. Determine the effectiveness of the modifications by comparing successful animal crossings pre- and post-construction; and by comparing animal-vehicle collisions pre- and post-construction. Weight the analysis if necessary by adjusting for changes in traffic volume over time.

6. Provide baseline data to help determine the need for, and most effective sites for, the construction of additional improvements or other mitigation techniques.
7. Conduct a thorough review of literature (published and in-house) to further understand the techniques and effectiveness of re-directing animal movements toward safe crossing areas.

These objectives address the following priority issues identified by MDT in the Request for Proposals:

- Do highways fragment populations?
    - How do animals react to the structure (and other features) of the road (and road designs)?
- Do crossing structures/fencing (or other design modifications) work?
    - To what extend do bridges and bridge length provide connectivity and maintenance of ecological processes?
    - For what species?
    - Where should they be located?
    - What are fencing requirements?
    - Is fencing effective for keeping animals off the road, without trapping animals on the road?

Additionally, the data from this study will be important to the Bozeman Pass Working Group's efforts to guide land management decisions and conservation efforts in the Bozeman Pass area for wildlife connectivity. While this research proposal does not request funds specifically for this collaborative effort with the Bozeman Pass Working Group, the results from this study will be used to address the following priority issues:

- Can highway corridors be designed to facilitate connectivity of populations/ecological processes?
    - Can easements maintain a more open connectivity and, if so, how big do they need to be?

Benefits

The Bozeman Area Wildlife Linkage and Highway Safety Pilot Study will provide important information to MDT for mitigating wildlife-vehicle collisions in a crucial wildlife corridor, and for understanding and facilitating wildlife movement as an integral part of ecosystem function. Study results will provide an analysis of the effectiveness of fences and cattle guards at re-directing animal movement through existing structures that cross under the freeway.

If these mitigation structures are effective in the Bozeman vicinity, wildlife-vehicle collisions will be greatly reduced with a significant cost savings to the general motoring public. Increased use of existing crossing structures will also increase motorist safety and provide an invaluable service to the health of Montana's wildlife species. If animals are unable to cross the highway successfully through existing structures after fences are installed (Phase Two), the project will provide data on recommendations on other mitigation alternatives. This project has the possibility of providing a low cost solution at sites with a high probability of success, and providing data for further design modifications if necessary. The results should be applicable to similar animal crossing areas throughout the state of Montana.

This project will also generate increased local interest and involvement. Landowners on both sides of the highways at these project sites have expressed interest and concern for wildlife and human safety. The Gallatin Valley Land Trust and the Trust For Public Lands are currently working with landowners to secure conservation easements in areas critical for wildlife; they have agreed to work with the landowners involved to help ensure that animals will have secure habitat on both sides of these bridge sites. The results of this study will help landowners see that MDT is committed to trying to alleviate the barrier of I-90 to animal movements. This is important to their willingness to commit land to conservation easements in this important wildlife linkage area.

Research Plan

The research plan is comprised of four parts:

1) Field data collection. (CERI)
    a. Animal-vehicle collision locations
        i. Under current conditions
        ii. After design modification
    b. Animal highway crossing locations
        i. Under current conditions
        ii. After design modification
    c. Attempted animal crossing locations
        i. Under current conditions
        ii. After design modification

2) Habitat mapping of wildlife crossing 'corridors' (CERI)
    a. Refinement of existing GIS least-cost-path models
    b. Comparison with field data
    c. Further model refinement if necessary
    d. Application to other animal crossing areas

3) Thorough literature review of crossing structures and techniques to re-direct animal movement (CERI and WTI).

4) Outside of the requested budget for this proposal, CERI and WTI will use the field data and GIS models to advise on wildlife habitat protection on both sides of the highway at crossing sites to maintain connectivity.
    a. Implementation with private landowners and regional land trusts
    b. Implementation with public land management agencies

The study will continue to document the use of existing 'crossing' structures by wildlife for movement from one side of the highway to the other. Simultaneously, data is being collected on the frequency with which wildlife cross over the surface of the highway, and the number of animal-vehicle collisions that occur. The initial part of the study (2001) was used for calibration of the study design. During winters, observations will continue to be made of snow tracks for several days following each fresh snowfall. Track plates will also be placed beneath bridges; these will provide data about small mammals and perhaps amphibians that will be difficult to observe or photograph. Where possible, track counts will be augmented with remote cameras placed at 'crossing' structures to photograph animals moving underneath the highway; these will provide data about use of the 'crossing' structures during times when observers are not present. Data are recorded on field data forms and transcribed into a computer database. Locations of highway crossings and vehicle-animal collisions are mapped in the field and recorded with a GPS receiver or estimated to the nearest 1/10th of a mile between mileposts.

Working with private landowners and land management agencies at these sites to maintain current habitat conditions during the course of the study is an important activity to ensure that the scientific results are interpreted correctly and are available for use by decision-makers and the general public. Most of this liaison will be accomplished by land trusts and conservation groups in the Bozeman area such as American Wildlands and The Gallatin Valley Land Trust. To support implementation on wildlife habitat bordering the I-90 right of way, CERI and WTI will provide materials and make some public presentations of results. Landowners have been contacted and negotiations and discussions are ongoing with the Gallatin Valley Land Trust and the Trust For Public lands in order to protect, maintain or improve the wildlife habitat on both sides of I-90 after the project is completed.

Technical objectives of the study

This study will be accomplished through the following tasks:

Phase One (2003 until wildlife fencing is installed on MRL bridge reconstruction project)

1. Document the number of animal-vehicle collisions at the study site under current conditions.

2. Document the frequency of the under-bridge crossings and over-highway crossings at the study site for various species throughout the year under current conditions

3. Refine existing GIS analysis of wildlife habitat and least-cost-path wildlife 'corridors' to include additional data layers such as slope, riparian areas, and existing barriers to movement.

4. Conduct literature review, summarize data, and prepare interim report.

Phase Two (for one year beyond date when wildlife fencing is installed on MRL bridge reconstruction project)

5. Document the number of animal-vehicle collisions at the study site after construction of wildlife mitigation design modifications.

6. Document the frequency of the under-bridge crossings and over-highway crossings at the study site for various species throughout the year after construction of wildlife mitigation design modifications.

7. Determine the effectiveness of the wildlife mitigation modifications by comparing pre- and post-construction successful animal crossings and animal-vehicle collisions. The analysis will be weighted if necessary by adjusting for changes in traffic volume over time.

8. Collaborate with local government, land trusts, conservation groups, private landowners and the public to make presentations of pilot study results and MDT's use of best management practices.

9. Summarize data and prepare final report.

Products

Prior to this study, WTI and CERI will submitted a technical memorandum to MDT detailing design recommendations for fencing, cattle guards, and landscaping to be considered for incorporation into the reconstruction design of the MRL bridge. Following the initiation of this study, CERI will submit brief quarterly progress reports and a comprehensive draft and final

report to MDT. Quarterly reports will summarize the data collected during each quarter and will include GIS-based habitat maps, photographs, and a database of observations for the study area. These and additional observations and data will be incorporated into an interim report summarizing the pre-construction conditions as well as a post-construction draft final report for MDT review. After a 20-day review period, a final report will be produced for printing and distribution. WTI and CERI will prepare PowerPoint presentations to facilitate the communication of the study results to local government, NGOs, local landowners and citizens, and other interested parties.

Implementation

CERI and WTI will provide MDT with wildlife mitigation recommendations for the MRL Bridge Reconstruction Project prior to the start of this project. These recommendations may involve increased fencing, installation of modified cattle guards at interchanges, changes in Jersey barriers, possible landscaping and vegetation planting on the highway ROW and at the MRL bridge site. CERI and WTI will collaborate with MDT to finalize the details of design of mitigation solutions at the study site. Any modifications on private land such as additional fencing will be done in collaboration with willing landowners.

The result of the research will be evaluation of the design modifications for their effectiveness in increasing motorist safety and the transit of wildlife across busy highways. If these mitigation efforts prove to be effective they will be applicable throughout western Montana in areas with similar topography and wildlife species. If determined ineffective at re-directing animal movements and improving motorist safety, this research will provide data for alternate engineering solutions in the future. This project focuses on areas with a high probability of use by wildlife and should provide sufficient data for accurate conclusions at a much lower cost than installing new underpass or overpass structures.

To ensure the long-term effectiveness of successful highway modifications, CERI and WTI will provide data and results to local government officials, local land trusts, private landowners, and public land management agencies to help maintain habitat connectivity beyond the highway crossings through conservation easements, zoning, land purchases, public land management and other means as appropriate. We will also consult with local conservation organizations that have helped to raise awareness of the problem and have greatly increased local interest in its solution.

Time Schedule

The project timeline was developed to show activity for each of the technical tasks throughout the study. The estimated start date of Phase 1 is February 1, 2003 and the transition to Phase 2 will occur when the MRL bridge reconstruction has been completed and the wildlife fencing is installed (estimated for this time table to be August 1, 2004). Phase 2 data collection will last for one year after the wildlife fencing is in place, and analysis and the final reporting will take an additional 3 months. Table 1 shows when each task will be occurring.

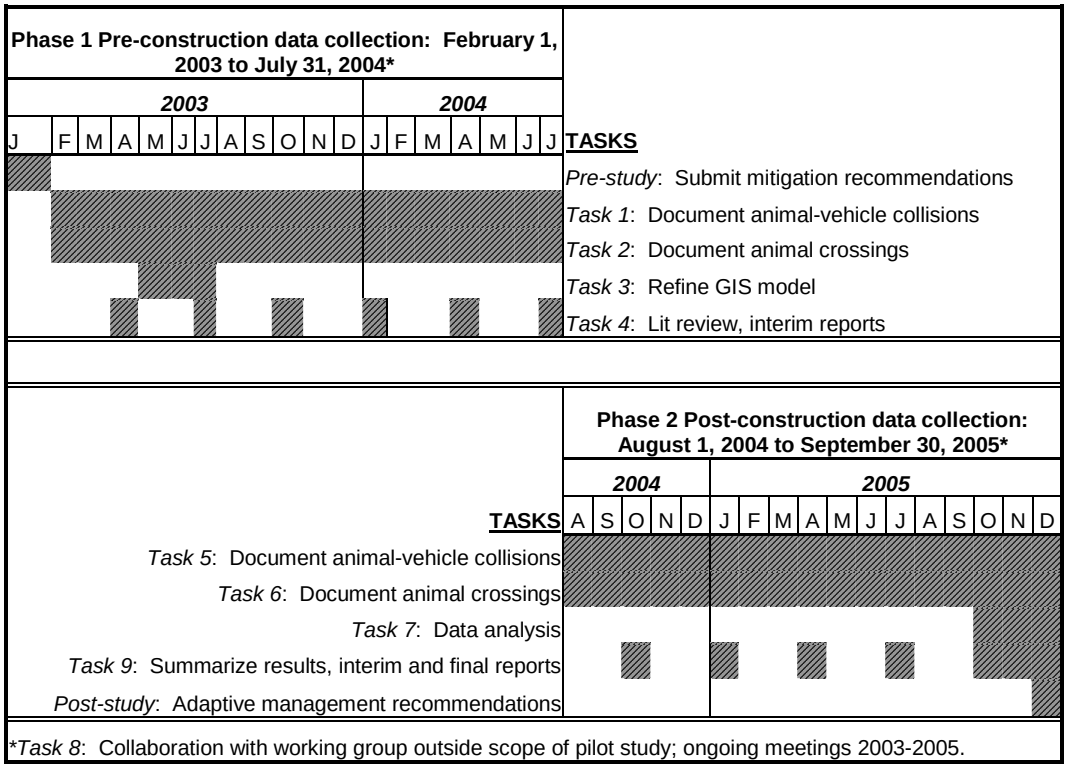

Table 1: Bozeman Area Wildlife Linkage and Highway Safety Study Time Schedule

Staffing

Amanda Hardy, MSc.
Amanda is a research ecologist with the Western Transportation Institute at Montana State University. Because this research will be subcontracted to CERI, Amanda will function as a liaison between MDT and CERI as needed. Amanda will assist CERI as needed to determine the effectiveness of the mitigation efforts. With these results, she will work cooperatively with

CERI, WTI, American Wildlands, Gallatin Valley Land Trust and MDT to make adaptive management recommendations if deemed necessary. Amanda will also work with MDT and CERI to disseminate and present results from this research.

EDUCATION
B.S. Biology—Fish and Wildlife Management, Montana State University, 1997
M.Sc. Ecology—Fish and Wildlife Management, Montana State University, 2001

TEACHING EXPERIENCE:
Teaching Assistant. Montana State University. Sept-Dec. 2001. Introductory Biology

EXPERIENCE
Thesis work included empirical modeling of behavioral, distributional, and stress hormone responses of bison and elk to types and levels of winter recreation in Yellowstone National Park. Other field experience includes: handling bison, pronghorn antelope, elk, coyotes; locating free-ranging animals using radio-telemetry and collecting behavioral data; serving as a fire monitor; controlling exotic vegetation; conducting bear spawning stream surveys. Worked for several years on NEPA compliance documents Yellowstone National Park's Planning Office. Currently involved in numerous national efforts to incorporate ecological issues into transportation planning, design and construction management practices.

CURRENT RESEARCH
Evaluation of Wildlife Crossing Structures on US 93, Evaro to Polson: PI on Phase I, pre-construction field data collection and finalization of long-term research plan.

PROFESSIONAL AFFILIATIONS
Phi Kappa Phi Honorary Society: Member
The Wildlife Society: Member
Transportation Research Board Animal Vehicle Collision Sub-Committee: Member
Transportation Research Board Environmental Analysis in Transportation Committee: Liaison between Animal Vehicle Collision Sub-Committee and Environmental Analysis Committee
Transportation Research Board Natural Resources and Stewardship Sub-Committee: Task-force member for the establishment of an Ecology and Transportation Sub-Committee

Pat McGowen, P.E.
Pat is a research engineer with the Western Transportation Institute at Montana State University. Pat will serve as a consultant on site design recommendations; primarily to help incorporate site specific modifications to the planned bridges on highway 86 and interstate 90.

EDUCATION
M.S. in Civil Engineering with emphasis in transportation at MSU-Bozeman. December 1996.

B.S. in Civil Engineering at Montana State University, Bozeman, MT. December 1994.

PROJECT EXPERIENCE
Animal Vehicle Crash Mitigation Using Advanced Technologies (1999 – 2002).
California/Oregon Advanced Transportation Systems Corridor (1998-1999)
Evaluation of Sacramento Canyon Advanced Speed Warning Signs (1998-2000)
Greater Yellowstone Rural ITS Priority Corridor (1996-2002)

WORK HISTORY
Western Transportation Institute (1995-present) – Worked as a graduate research assistant and currently as a research associate supporting or managing research projects.

VanDyke Construction (1994) - Worked as administrative aide, performing quantity take offs, bid calculations, project management, and shop drawings for construction of water and sewer systems.

Montana Department of Transportation, Billings, MT (1993) - Summer intern working on two major road designs, soil testing, and surveying.

PROFESSIONAL AFFILIATIONS
·Institute of Transportation Engineers Associate Member
·Intelligent Transportation Society Involvement with Advanced Rural Transportation Systems committee, student chapters, and Advanced Public Transit Systems Committee
·Montana State Board of Professional Engineers and Land Surveyors Professional Engineer, 12115PE

F. Lance Craighead, PhD

Lance will be responsible for the study design and implementation and will direct the field studies. His duties will include liaison with Department of Transportation engineers and planners as the study proceeds to determine the best options for mitigation of wildlife conflicts. Lance is the Executive Director of the Craighead Environmental Research Institute in Bozeman and serves as Vice-President for the Northern Rockies Conservation Cooperative in Jackson, Wyoming. He is also an Adjunct Assistant Professor of Biology at Montana State. His current research interests center on Reserve Design: GIS-based reserve design using the habitat needs of key carnivore umbrella species as a basis for designing protected areas in Montana, Wyoming, and British Columbia. As a critical part of Reserve Design, Lance conducts research on the role of highways as barriers to animal movements.

EDUCATION
B.A. Biology, Carleton College, Northfield MN, 1969
M.Sc. Wildlife Biology, University of Wisconsin-Madison, Madison WI, 1976

Ph.D. Biological Sciences, Montana State University, Bozeman MT, 1994

ACADEMIC APPOINTMENTS
Affiliate Assistant Professor, Biology, Montana State University, 1994
Adjunct Assistant Professor, Biology, Montana State University, 1996

MAJOR ADMINISTRATIVE RESPONSIBILITIES
Vice President, Northern Rockies Conservation Cooperative, Board of Directors, 1988-present
Research Director, Craighead Environmental Research Institute, director of research program, 1980-1998
Executive Director, Craighead Environmental Research Institute, 1998-present

CURRENT RESEARCH
Reserve design: GIS-based reserve design based upon resource selection functions of key carnivore umbrella species in Montana, Wyoming, British Columbia and Southeast Alaska. Detection and monitoring of grizzly bear habitat use and movements: Kitlope Wilderness and Kakwa Provincial Park, British Columbia. Integrating ranching and wildlife conservation on private lands; Tom Miner Basin, Montana.

PROFESSIONAL AFFILIATIONS
IUCN World Commission on Protected Areas (World Conservation Union): Member
SIGMA XI: Member
The Wildlife Society: Member
International Bear Association: Member
American Association for the Advancement of Science: Member
Society for Conservation Biology: Member
Society for Conservation GIS: Member

April Craighead, M.Sc.

April Craighead is a consulting field biologist for the project. She will be responsible for the supervision of observations, snow tracking surveys, establishing and monitoring remote camera sites, and the recording of data when the two principal investigators are unavailable. She will be available to fill in as a field biologist in the case of emergencies or schedule conflicts of the field crew. She has a wide variety of field experience in detecting the presence and movement of animals, mostly from the Rocky Mountains.

EDUCATION:
B.A.; Biology (Ecology, Behavior, and Evolution).University of California, San Diego, 1989.
M.Sc.; Montana State University, 2000

TEACHING EXPERIENCE:
1997-1998 Teaching Assistant. Montana State University. Jan.-May. Introductory Biology

FIELD EXPERIENCE:
Field experience includes: research on nesting raptors in Yellowstone National Park; analysis and identification of raptor pellets; trapping and handling migrating raptors; surveys of avian diversity and distribution; surveys for threatened and endangered species at U.S. Air Force missile sites in Montana; small mammal trapping in the Pryor mountains of Montana; wetland vegetation monitoring in northern Idaho; census and behavior of bowhead and beluga whales in Beaufort Sea; riparian inventory for U.S. Forest Service in Utah; survey of nesting raptor sites along natural gas pipeline route in northern Idaho; seabird and marine mammal population census in Prince William sound and Kenai peninsula, Alaska; assisted in grizzly bear (*Ursus arctos*) capturing, handling, tagging, radio-collaring, and blood sampling for genetic research in Alaska.

Staff Person-Hours

		Tasks listed under technical objectives									
		Phase 1: 2003-2004				***Phase 2: 2004-2005***					
Name or Classification	**Role**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8***	**9**	**TOTAL**
						hours					
Lance Craighead	CERI PI	20	40	40	80	10	20	20	n/a	80	310
April Craighead	CERI consultant	80	120	40	80	40	60	20	n/a	80	520
GIS Technician	CERI GIS analysis	0	0	160	20	0	0	0	n/a	80	260
CERI Administration	CERI Support	0	0	0	80	0	0	0	n/a	80	160
	Sub-total CERI hours:	100	160	240	260	50	80	40	0	320	1250
Amanda Hardy	WTI PI	20	30	0	40	10	20	5	n/a	60	185
Pat McGowen	WTI consultant	0	0	0	30	0	0	0	n/a	40	70
WTI Technical Editor	WTI Editor	0	0	0	10	0	0	0	n/a	10	20
Jeralyn Brodowy	WTI Administration	0	0	0	20	0	0	0	n/a	20	40
	Sub-total WTI hours:	20	30	0	100	10	20	5	0	130	315
	TOTAL:	120	190	240	360	60	100	45	0	450	**1565**

Table 2: Bozeman Pass Wildlife Linkage and Highway Safety Pilot Study breakdown of person hours by technical tasks. Task 8 is outside the scope and budget of this research proposal although WTI and CERI staff will be collaborating with the Bozeman Pass Working Group throughout the course of this proposed study. *NOTE: The level of effort proposed for principal and professional members of this research team will not be changed without the written consent of MDT.*

Facilities

Researchers will have access to the facilities of Montana State University (MSU) as well as the GIS lab at Craighead Environmental Research Institute (CERI). MSU facilities include the Remote Sensing Lab, the Geographic Information and Analysis Center, the Library, and the Computer System. Office space with phones, fax, printers, copiers, etc. is also available at CERI. Researchers will provide vehicles, computers, and the basic field tools and equipment needed for the study. Specific equipment that will be purchased for the project includes remote cameras, tracking plates, and hand-held GPS receivers.

MDT Involvement

MDT assistance has been invaluable for consultation on design modifications and options. Research staff discussed site-specific mitigation options with MDT biologists, engineers and administrators to explore the feasibility of incorporation into highway design for increased wildlife use. Field visits to the study area with MDT personnel were conducted during the winter of 2002.

MDT will need to be an integral part of the proposed wildlife exclusion fencing project, but MDT's involvement will be limited primarily to construction and maintenance of the wildlife fence and installation of the ungulate/cattle guards. Fencing recommendations entitled: "Design Recommendations for Wildlife Fencing on I-90 Bozeman Pass To be incorporated with: Project IM 90-6(88)314 MRL Overpass 7km E of Bozeman" have been provided to Jason Giard, District Administrator of the Butte District of MDT. For the preferred alternatives, this will require the installation of about 1.6 miles of fence (Options A-1 plusB-1 plus C-2 in the Design Recommendations supplied: see Appendix). Although the fence should greatly reduce animal-vehicle collisions in the project area, some maintenance work may still be required to remove animal carcasses. Once the fence is installed, CERI and WTI staff will monitor wildlife use of the area to determine the effects of the fencing in relation to monitoring data collected before the fence was installed.

In the previous proposal, CERI asked MDT to install temporary traffic counters on Bozeman Pass. MDT will no longer need to do this since WTI has recently agreed to provide CERI with the use of temporary traffic counting equipment for this project. CERI will coordinate with WTI on the proper times and duration for the temporary traffic counters to be installed in the Bozeman Pass vicinity.

MDT staff will also be asked to attend additional workshops with biologists, local conservationists, regional landtrusts, and highway engineers in Bozeman. Because of overlapping ROWs where the MRL line crosses under I-90, CERI and WTI would like to coordinate with both MDT and MRL staff to ensure that all parties' needs are met. CERI and WTI have made initial contact with the MDT representative (Dewey Lonnes) to MRL and will continue to work with him and appropriate MRL staff to insure that MRL is informed on the progress of this project. In addition, access to any MDT databases or data collection about wildlife-vehicle collisions will be sought.

Budget

This document includes several budget breakdowns for the proposed study. Table 3 outlines the budget for the entire study with the sub-contract work with CERI totaled but not broken down in terms of CERI's time and expenses. Table 4 shows only the anticipated sub-contract expenses. In addition to those budget breakdowns, the proposed budget is shown with respect to both Federal and State fiscal years. The total proposed duration of the project is 35 months having a start date of February 1, 2003 and ending December 31, 2005. Table 5 defines the months in a fiscal year used in calculating the state and federal fiscal year budget breakdowns. Tables 6 and 7 show the budget by Federal and State fiscal years, respectively.

Table 3. Proposed budget for the Bozeman Pass Wildlife Linkage and Highway Safety Pilot Study. Includes the total cost of the Craighead Environmental Research Institute (CERI) sub-contract budget and all Western Transportation Institute expenses (CERI sub-contract proposed budget is detailed on next page, Table 4).

Budget	WTI Team				Other Direct Expenses			Totals
	Amanda Hardy (Co-PI)	Pat McGowen (Engineer)	Jeralyn Brodowy (Business Manager)	Technical Editor	Travel	Sub-contract to CERI (see following budget)	Supplies and Communications	Total Hours Total Costs
Task Title	$20.15	$31.96	$22.02	$12.34				
	40	0	0	0				40
Phase 1: Task 1	$806.00	$0.00	$0.00	$0.00	$ 100.00			$906.00
	60	0	0	0				60
Phase 1: Task 2	$1,209.00	$0.00	$0.00	$0.00	$ 100.00			$1,309.00
	0	0	0	0				0
Phase 1: Task 3	$0.00	$0.00	$0.00	$0.00				$0.00
	80	30	20	10				140
Phase 1: Task 4	$1,612.00	$958.80	$440.40	$123.40			$ 100.00	$3,234.60
	20	0	0	0				20
Phase 2: Task 5	$403.00	$0.00	$0.00	$0.00	$ 100.00			$503.00
	40	0	0	0				40
Phase 2: Task 6	$806.00	$0.00	$0.00	$0.00	$ 100.00			$906.00
	10	0	0	0				10
Phase 2: Task 7	$201.50	$0.00	$0.00	$0.00				$201.50
	0	0	0	0				0
Phase 2: Task 8	$0.00	$0.00	$0.00	$0.00				$0.00
	120	40	40	10				210
Phase 2: Task 9	$2,418.00	$1,278.40	$880.80	$123.40			$ 100.00	$4,800.60
TOTAL HOURS	370	70	60	20		1250		1770
TOTAL DIRECT COSTS (includes ben.)	$7,455.50	$2,237.20	$1,321.20	$246.80	$400.00	$36,150.00	$100.00	$47,910.70
Indirect Costs at 15%	$1,118.33	$335.58	$198.18	$37.02	$ 60.00	$ 3,750.00	$ 15.00	$5,514.11
Total Project Costs	$8,573.83	$2,572.78	$1,519.38	$283.82	$ 460.00	$ 39,900.00	$ 115.00	***$53,424.81***

Table 4. Proposed budget for Craighead Environmental Research Institute (CERI) Sub-Contract.

	Lance Craighead (Co-PI)	April Craighead (Field Consultant)	GIS Technician	Administrative Support	Travel (5000 miles @ $0.34/mile)	GIS expenses	Supplies, Communications, Misc.	Total Hours Total Costs
Task Title	$25.00	$20.00	$20.00	$10.00				
	20	80	0	0				100
Phase 1: Task 1	$500.00	$1,600.00	$0.00	$0.00	$ 425.00			$2,525.00
	40	120	0	0				160
Phase 1: Task 2	$1,000.00	$2,400.00	$0.00	$0.00	$ 425.00			$3,825.00
	40	40	160	0				240
Phase 1: Task 3	$1,000.00	$800.00	$3,200.00	$0.00				$5,000.00
	80	80	20	80				260
Phase 1: Task 4	$2,000.00	$1,600.00	$400.00	$800.00		$3,000.00	$2,000.00	$9,800.00
	10	40	0	0				50
Phase 2: Task 5	$250.00	$800.00	$0.00	$0.00	$ 425.00			$1,475.00
	20	60	0	0				80
Phase 2: Task 6	$500.00	$1,200.00	$0.00	$0.00	$ 425.00			$2,125.00
	20	20	0	0				40
Phase 2: Task 7	$500.00	$400.00	$0.00	$0.00				$900.00
	0	0	0	0				0
Phase 2: Task 8	$0.00	$0.00	$0.00	$0.00				$0.00
	80	80	80	80				320
Phase 2: Task 9	$2,000.00	$1,600.00	$1,600.00	$800.00		$2,500.00	$2,000.00	$10,500.00
TOTAL HOURS	310	520	260	160				1250
TOTAL DIRECT COSTS	$7,750.00	$10,400.00	$5,200.00	$1,600.00	$1,700.00	$5,500.00	$4,000.00	***$36,150.00***

Table 5. Proposed project starting and ending dates and numbers of months used to calculate Federal and State fiscal year estimated annual project expenditures.

Federal Fiscal Years	Start & End Dates	Duration (mo.)
FY-03	2/1/03 to 9/30/03	8
FY-04	10/01/03 to 9/30/04	12
FY-05	10/1/04 to 9/30/05	12
FY-06	10/1/05 to 12/31/05	3
State Fiscal Years		
FY-03	2/1/03 to 6/30/03	5
FY-04	7/1/03 to 6/30/04	12
FY-05	7/01/04 to 6/30/05	12
FY-06	7/01/05 to 12/31/05	6

Table 6. Proposed project expenditures broken down by Federal fiscal years.

	Federal Fiscal Years				Totals
	FY-03	**FY-04**	**FY-05**	**FY-06**	
Salaries	$ 2,026.67	$ 3,040.01	$ 3,040.01	$ 760.00	$ 8,866.69
Benefits	$ 547.20	$ 820.80	$ 820.80	$ 205.20	$ 2,394.01
In-State Travel	$ 91.43	$ 137.14	$ 137.14	$ 34.29	$ 400.00
Supplies, Commun.	$ 22.86	$ 34.29	$ 34.29	$ 8.57	$ 100.00
Subcontract	$ 8,262.86	$ 12,394.29	$ 12,394.29	$ 3,098.57	$ 36,150.00
Total Direct Costs	$ 10,951.02	$ 16,426.53	$ 16,426.53	$ 4,106.63	$ 47,910.70
Overhead	$ 1,260.37	$ 1,890.55	$ 1,890.55	472.638	$ 5,514.11
Total Project Cost	$ 12,211.39	$ 18,317.08	$ 18,317.08	$ 4,579.27	**$53,424.81**

Table 7. Proposed project expenditures broken down by State fiscal years.

	State Fiscal Years				Totals
	FY-03	**FY-04**	**FY-05**	**FY-06**	
Salaries	$ 1,266.67	$ 3,040.01	$ 3,040.01	$ 1,520.00	$ 8,866.69
Benefits	$ 342.00	$ 820.80	$ 820.80	$ 410.40	$ 2,394.01
In-State Travel	$ 57.14	$ 137.14	$ 137.14	$ 68.57	$ 400.00
Supplies, Commun.	$ 14.29	$ 34.29	$ 34.29	$ 17.14	$ 100.00
Subcontract	$ 5,164.29	$ 12,394.29	$ 12,394.29	$ 6,197.14	$ 36,150.00
Total Direct Costs	$ 6,844.39	$ 16,426.53	$ 16,426.53	$ 8,213.26	$ 47,910.70
Overhead	$ 787.73	$ 1,890.55	$ 1,890.55	$ 945.28	$ 5,514.11
Total Project Cost	$ 7,632.12	$ 18,317.08	$ 18,317.08	$ 9,158.54	**$53,424.81**

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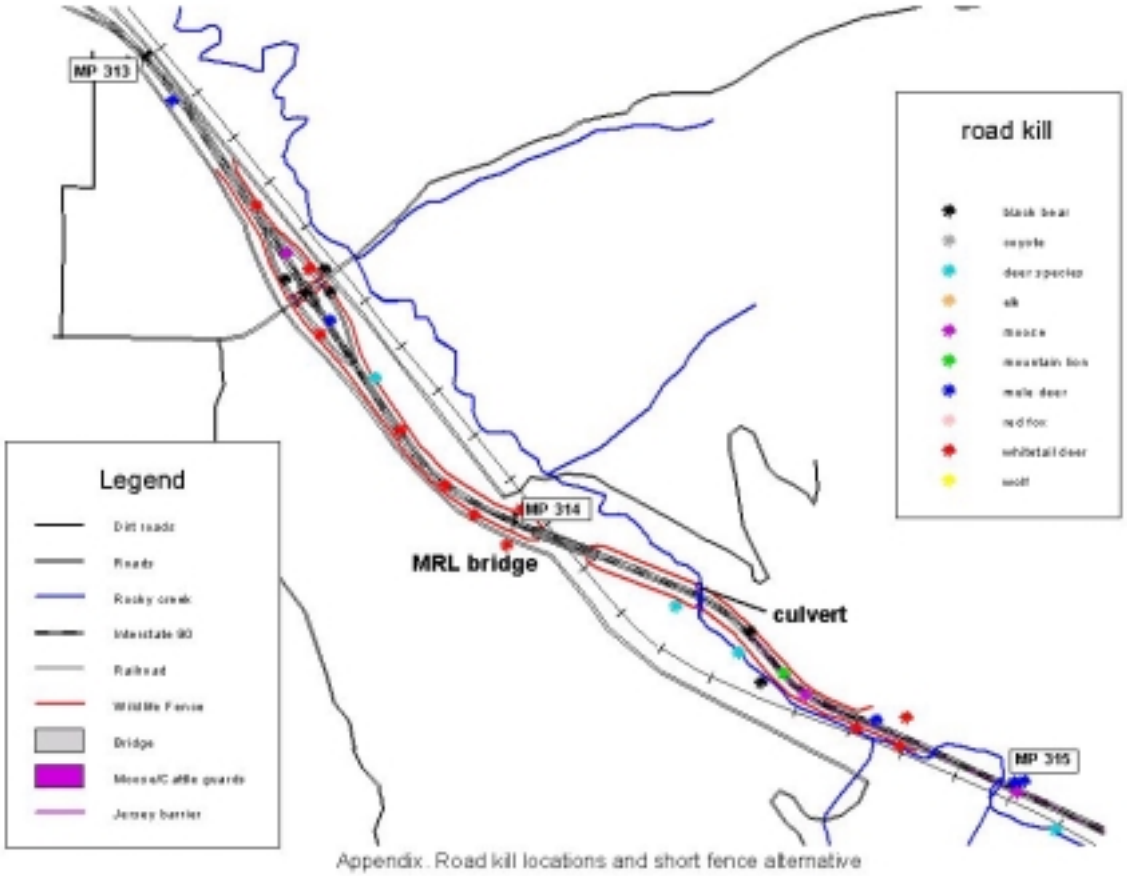
APPENDIX



Appendix. Road kill locations and short fence alternative